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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/549,494

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Takatomo Sasaki

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EXAMINER

SONG, MATTHEW J

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/549,494	Applicant(s) SASAKI ET AL.	
	Examiner MATTHEW J. SONG	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 November 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,9-12,17,18,20,26,37,39,41,44 and 45 is/are pending in the application.
- 4a) Of the above claim(s) 37,39 and 41 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,9-12,17,18,20,26,44 and 45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 1, 4, 9-12, 17, 18, 20, 26, and 44-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawamura et al ("Growth of a Large GaN single Crystal using the liquid phase epitaxy (LPE) Technique") in view of Sarayama et al (US 2002/0046695 A1) and Yamada et al (US 5,366,552).

Kawamura et al teaches a method of LPE comprising heating a reaction vessel (crucible) containing Na (an alkali metal) and gallium (Ga) to 800°C. (pg L4). Kawamura et al also teaches feeding a nitrogen containing gas (nitrogen and ammonia) and thereby allowing the Ga and

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nitrogen to react with each other to grow Group III nitride single crystals. (pg L4 and Abstract). Kawamura et al teaches a GaN single crystal was grown on a GaN thin film (Abstract), which clearly suggests a seed substrate. Kawamura et al also teaches GaN growth proceeds with dissolution of the high-pressure nitrogen gas into a solution system of metal Ga and Na (alkali metal) (pg L4), which clearly suggests dissolving a nitrogen-containing gas in the flux of the at least one metal element in which the at least one Group III element is dissolved to produce and grow the Group III nitride single crystals

Kawamura et al does not teach the dissolved nitrogen containing gas flows continuously on a surface of the substrate.

In a method of growing GaN from a molten mixture of Ga and Na, note entire reference, Sarayama et al teaches a method of GaN crystal growth comprising a heating a reaction vessel **2101** containing a Group III metal (Ga, Al, In) and an alkaline metal (Na, K) to form a mixed molten liquid ([0244]-[0250]). Sarayama et al also teaches feeding nitrogen and allowing Ga and nitrogen to react to grow GaN single crystals ([0244]-[0250]). Sarayama et al also teaches a convection arises in the mixed molten liquid because of a difference in temperature between the upper part and the lower part of the liquid holding vessel, thus efficient crystal growth is attained ([0246]), which clearly suggests heating the lower part of the vessel to generate heat convection in addition to heating the reaction vessel to prepare the flux. Sarayama et al also teaches feeding nitrogen continuously into the reaction vessel and creating a local concentration distribution of dissolved nitrogen to grow a high-quality group III nitride crystal with little nitrogen loss ([0062], [0075], [0078]), which clearly suggests dissolved nitrogen gas flows continuously on a surface of the substrate.

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It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kawamura et al by supplying nitrogen continuously, as taught by Sarayama et al, to grow a high-quality group III nitride crystal with little nitrogen loss ('695 [0062]).

The combination of Kawamura et al and Sarayama et al does not teach rocking the reaction vessel while the flux containing the at least one Group III element and the dissolved nitrogen containing gas flows continuously on a surface of the substrate.

In a method of Liquid Phase Epitaxy, note entire reference, Yamada et al teaches a rotation of a growth chamber is performed such that the angle of rotation of the growth chamber is a function of time elapsed, which period may be variable with the progress of liquid phase epitaxial growth (col 4, ln 1-40), which clearly suggests rocking the chamber during epitaxial growth. Yamada et al also teaches by tilting the chamber the solution is kept in a homogenous condition and liquid phase epitaxial growth is achieved uniformly. (col 4, ln 40 to col 5, ln 5). Yamada et al also teaches the movement of the chamber stirs the solution, thus accelerates growth rate. (col 5, ln 1-30 and col 2, ln 1-60).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kawamura et al and Sarayama et al LPE process by rocking the vessel, as taught by Yamada et al, to stir the melt containing the dissolved nitrogen gas, Group III metal and alkali metal, thereby improving uniformity and accelerating growth rate.

In regards to the metal element and at least one Group III element are stirred together with the nitrogen containing gas and mixed together by rocking, the combination of Kawamura et al and Yamada et al teaches crystal growth by combining Gallium metal, Na and nitrogen gas

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(Kawamura et al pg L4), and rotating the chamber during growth to stir (col 4, ln 25-65), this clearly suggests rocking to stir the metal, Group III and nitrogen gas.

Referring to claim 4, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches a thin film formed by MOCVD and growth on the film. (Kawamura pg L4).

Referring to claims 9-12, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches Ga metal to form GaN using a Na flux. (Kawamura pg L4).

Referring to claim 17, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches a temperature of 800°C and a pressure of 5 atm (0.5 MPa) (Kawamura pg L4).

Referring to claim 18, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches nitrogen and ammonia. (Kawamura pg L4).

Referring to claim 20, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches single crystals of GaN. (Kawamura pg L4).

Referring to claim 26, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches transparent GaN. (Kawamura pg L5).

Referring to claim 44, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches the dislocation density of bulk GaN grown by LPE should be extremely low (Kawamura pg L5). The combination of Kawamura et al, Sarayama et al and Yamada et al does not explicitly teach the dislocation density of $10^4/\text{cm}^2$ or lower are grown. The combination of Kawamura et al, Sarayama et al and Yamada et al teaches the same method, as applicant (See remarks above regarding claim 1); therefore It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kawamura et al,

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Sarayama et al and Yamada et al by optimizing the process to produce GaN crystal with low dislocation densities below $10^4/\text{cm}^2$.

Referring to claim 45, the combination of Kawamura et al, Sarayama et al and Yamada et al teaches growing large GaN single crystals with a size larger than 1 cm, and enlarging the crystal size until a required crystal size is obtained ('695 [0014] and [0203]-[0204]), thus It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kawamura et al, Sarayama et al and Yamada et al by increasing the size of the crystal to be greater than 2 cm to obtain crystals which can be used to manufacture substrates.

Response to Arguments

3. Applicant's arguments with respect to claims 1, 4, 9-12, 17-18, 20, 26, and 44-45 have been considered but are moot in view of the new ground(s) of rejection.

4. Applicant's arguments filed 11/25/2009 have been fully considered but they are not persuasive.

Applicant's argument that Kawamura et al fails to disclose the step of dissolving nitrogen gas in the flux of alkali metal in which Group III element is dissolved is noted but not found persuasive. Kawamura et al teaches dissolution of nitrogen gas into a solution system of metal Ga and Na (alkali metal) (pg L4).

Applicant's argument that Sarayama et al fails to disclose the step of dissolving nitrogen gas in the flux of alkali metal in which Group III element is dissolved is noted but not found

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persuasive. Sarayama et al discloses a mixed molten liquid comprising alkaline metal and group III metal and nitrogen gas is dissolved in the mixed molten liquid ([0062], [0073]-[0078]).

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Kawamura et al and Sarayama et al are not relied upon to teach rocking the reaction vessel. Yamada et al teaches rocking.

Applicant's argument that Yamada does not disclose particular materials included in solution is noted but not found persuasive. Applicant alleges that Yamada does not teach the method could be applied to GaN. Yamada broadly teaches application of the method to liquid phase epitaxial growth processes used for the production of light emitting diodes (col 1, ln 5-25), and does not limit the invention. Yamada et al also teaches growth of III-V semiconductors (GaAs, GaP) (col 6, ln 1-35). Therefore, a person of ordinary skill in the art would have found it obvious to apply the liquid phase epitaxial growth method taught by Yamada et al to the epitaxial growth method of Kawamura et al and Sarayama et al.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Yamada et al teaches rocking to keep a solution in a homogenous condition. Yamada et al is not relied upon to teach nitrogen containing gas or alkali metal. The combination of Kawamura, Sarayama and Yamada et al teaches all of the limitations of claim 1, as discussed above.

Applicant's argument that Yamada et al does not teach a gaseous reactant thus there is no reasonable basis to expect that rotating the reaction vessel has advantages in a system using nitrogen gas is noted but not found persuasive. Yamada et al teaches rocking the vessel to keep a solution in a homogenous condition (col 5, ln 1-5). One of ordinary skill in the art would expect this advantage to be obtained regardless if a gaseous reactant is used because the gaseous reactant is dissolved into the solution.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Scheel (US 3,858,553) teaches a rotating chamber for liquid phase epitaxial growth. (Abstract).

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. SONG whose telephone number is (571)272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on 571-272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
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MJS
March 13, 2010

/Robert M Kunemund/

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Primary Examiner, Art Unit 1792